2010 Fall AGU meeting, December 12-17, San Francisco, CA

Title: A coordinated effort to address space weather and environment needs

Abstract: The growing need for coordination of the many aspects of space environments is directly related to our increasing dependence on space assets. An obvious result is that there is a need for a coordinated effort to organize and make accessible the increasing number of space environment products that include space environment models and observations, material testing, and forecasting tools. This paper outlines a concept to establish a NASA-level Applied Spaceflight Environments (ASE) office that will provide coordination and funding for sustained multi-program support in three technical areas; (1) natural environments characterization and modeling, (2) environmental effects on materials and systems, (3) and operational and forecasting space environments modeling. Additionally the ASE office will serve as an entry point of contact for external users who wish to take advantage of data and assets associated with space environments, including space weather.

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A coordinated effort to address space weather and environment needs

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Fall AGU Meeting, December 17 , 2010

Outline

- Context
- Problem Statement and Solution
- Technical Content and Scope
- Organizational Structure
- Responsibilities
- Initial Steps
- Summary

Context

- The Nation's dependence on space assets is increasing in all contexts – personal, commercial, military, political
- House and Senate authorization language for NASA includes space weather explicitly
- 2009 NASA OCE Space Weather Report calls for a coordinated and focused effort
  - Improve Intra- and Inter-agency communication and cooperation in space weather related activities
  - Develop and implement standards and guidelines for space system radiation hardness and space environment risk mitigation
  - Faster turn around needed from Research to Operations with improved models

Problem Statement

- A gap exists between spaceflight environments knowledge and the application of this knowledge for multi-program ,cross cutting use.
  - Presently, each NASA project must fund, establish, and develop their individual spaceflight environments products with the potential consequences of:
    - Duplication of effort
    - Over/under engineering
    - Using inappropriate critical information
    - Acceptance of risk
- Problem
  - No funding for transition from research to applications
  - Lack of NASA coordination at the agency level
  - No one owns the problem

Solution Statement

- To resolve this problem, establish a NASA organization that will provide coordination and funding for sustained multi-program support in three technical areas that have a demonstrated need through customer pull. These technical areas are:
- **Natural Environments Characterization and Modeling**
- **Environmental Effects on Materials and Systems**
- **Operational Space Environments – Space Weather**

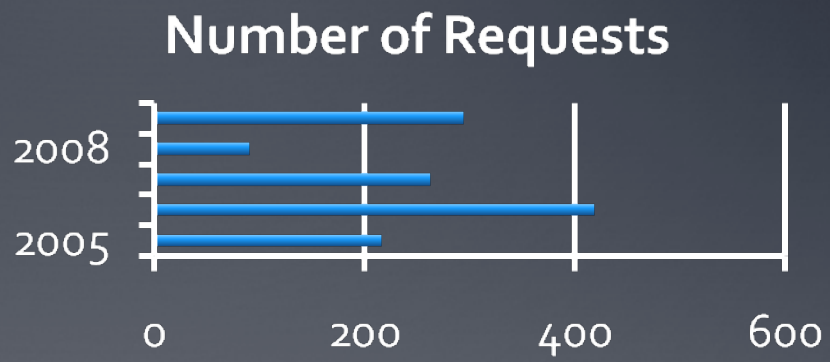
Spaceflight Environment Scope: All Natural Environments that have influence in the design, manufacturing, development, and operation of spaceflight systems. Terrestrial surface and atmosphere, planetary surface and atmospheres, LEO to GEO, and interplanetary space.

Proposed Applied Space Flight Environments (ASE) Program

- A NASA program
- Cross cutting – addresses internal needs in
  - SMD – augments research funds by focusing on transition and provides valuable space environment data
  - ESMD – provides engineering input for design, and prediction for environment to be encountered by human and robotic explorers to increase their productivity
  - SOMD – venue to develop operational tools based on sound data and proven models
  - NESC – Advancement of the state-of-the-art by Independent organization
- Coordinating – uses existing agency pockets of expertise
- Cost-Savings – Large volumes of existing data are available to enhance existing tool sets and new developments
- Conduit – serves as entry point for users and partners external to NASA

Natural Environments Characterization and Modeling

- Natural environments models are used, primarily, in the design phase of the a program cycle.
- Discipline Areas
  - Terrestrial and Planetary Atmospheres
  - Ionizing Radiation Environments
  - Plasma Environments
  - Extraterrestrial Surfaces
  - Interplanetary Environments
  - Spacecraft Charging

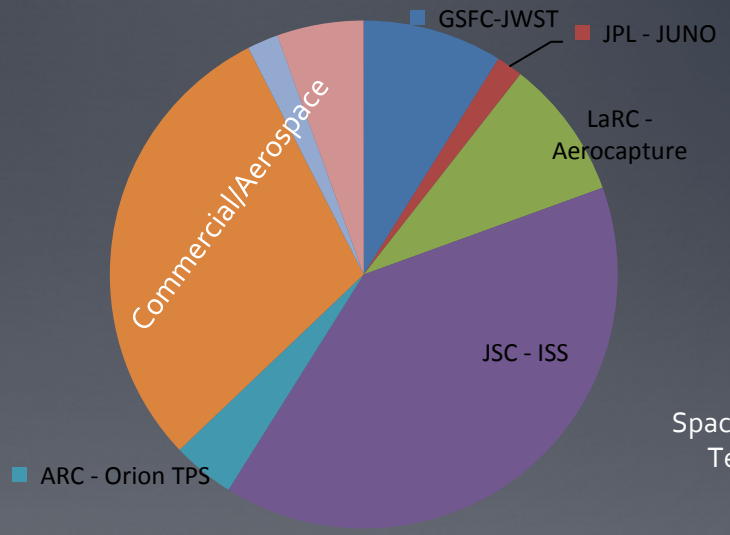


http://see.msfc.nasa.gov/index.html

- Demonstrated need: MSFC/EV44 maintains the Space Environments & Effects (SEE) Program web site and continues to distribute SEE products to the NASA, US, and the international aerospace community even though the SEE Program was terminated in 2005.
  - No central NASA Organization exists to develop these unique SEE products.
  - No funding is available to improve the SEE products.
  - Over 1000 requests for products have been received and products were distributed in the last 5 years.
  - NASA ,Government, and Aerospace Industry Programs use these SEE products.
  - Most SEE products are approaching 10 years without update.

Environmental Effects on Materials and Systems

- Materials performance assessments determined through ground-lab and spaceflight testing is critical to mission success
- Discipline areas
  - Materials Test
  - Ground-Laboratory Test Data
  - Test Facilities
  - Flight Data
  - Measurement Instrumentation
  - Contamination



Space Environmental Effects Testing at MSFC/EM50 2008-2010

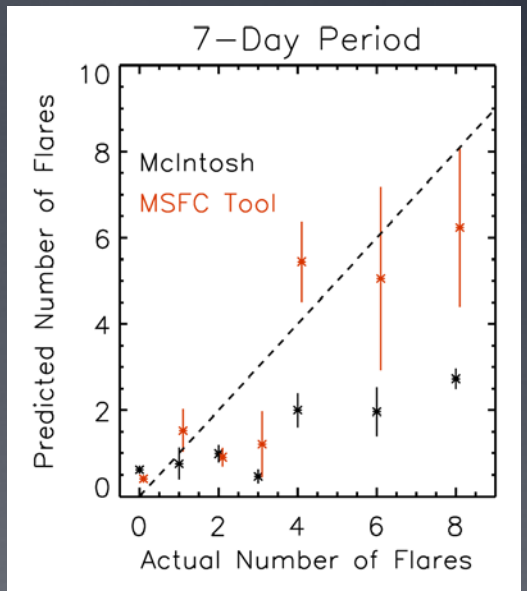
- Demonstrated Need:
  - Customer pool for Space Environmental Effects testing and analysis includes NASA centers, DoD, commercial space and material developers
  - Materials test and analysis data exists in many locations, but is not readily available to the aerospace community as a compiled database
  - No organized approach exists to develop new data for new technology development

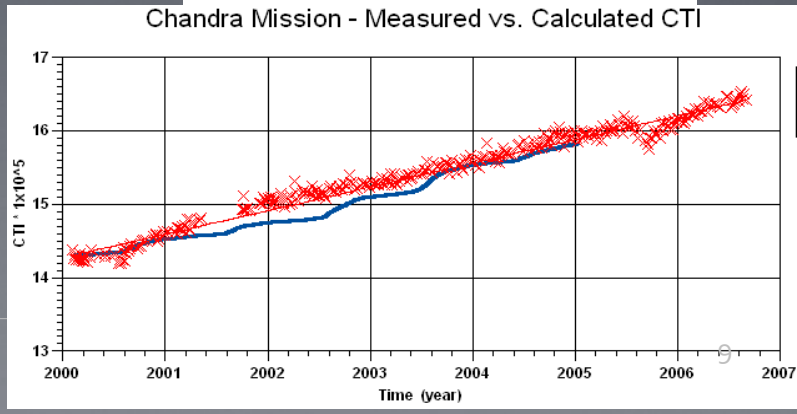
Operational Space Environments

Operational environments are altered by the dynamic nature of the space environment.

- Discipline Areas:
  - Solar and Heliospheric physics
  - Magnetosphere and Ionosphere dynamics
  - Flight instruments and Data
  - Space Weather predictive models

- Demonstrated Need:
  - For space-weather forecasting NOAA and others currently use a version of the McIntosh classification scheme to predict the occurrence rate of X and M-class solar flares. These are the largest and most dangerous flares produced by the Sun and their affects on spaceflight systems must be accounted for in flight operations. The graph compares the performance of the McIntosh prediction scheme against the MSFC All-Clear model.
  - Chandra Radiation Model was developed to map the 100-200 kev protons outside of the radiation belts. CRM is now integrated in the off-line mission planning system





ASE Management

Senior Subject Matter Experts

Natural Environmental Characterization and Modeling

- o Ionosphere/Plasma Thermosphere
- o Ionization Radiation
- o Interplanetary Environments
- o Terrestrial and Planetary Environments
- o Extraterrestrial surfaces
- o Spacecraft Charging

Environmental Effects on Materials and Systems

- o Ground Testing
  - Space Environmental Effects
  - Extraterrestrial Surfaces & Atmospheres
- o Flight Experiments
- o Contamination
- o Measurement Instrumentation

Operational Space Environments

- o Solar and Heliopsheric variability
  - CMES & Flares
- o Magnetospheric dynamics
  - Magnetic Storms
  - Radiation Belt
- o Ionospheric Variability
  - Scintillation
  - Auroral disturbances

Cooperative Interface to ASE

NASA Organization
- Living With a Star/HQ
- CCMC/GSFC
- NEPP/GSFC
- MEO/MSFC
- ODPO/JSC
- SRAG/JSC
- SWxWG/OCE

Non-NASA Organizations
- NOAA/Space Weather Ctr
- DoD AFRL/NRL/Army
- National Laboratories
- Private Industry
- International Partners

Integrated Support

Education
Engineering Organization
Science Organization

Technology Transfer
Reference Materials

Working Group Structure and Function

EXAMPLE

Office

ASE Management

Task Call

Prioritize

Technical Area

Natural Environments Characterization and Modeling

Working Group

Ionizing Radiation

Prioritize

Membership

NASA
Other Government Agencies
Industry
Academia
International Partners

Tasks and needs
SME's
POC's for tech Coordination

Long-lead time needs
Short-term needs
Technology needs
Risk mitigation issues

Subject Matter Experts

Programs/Projects
Technical Committees
Academic Researchers

Responsibilities

- Fund the transition from research to applications
  - New and existing models , data sets
- Respond to user needs – internal and external to NASA
  - Product development
  - Technical assistance
- Facilitate flight experiment opportunities
- Coordinate space weather observations for NASA operations
- Provide a coordinated effort to capture, archive, and distribute spaceflight environments data
- Develop ASE guidelines for design, development, manufacturing, and operation
- Enable material advancement and space system improvements
- Provide a forum for Subject Matter Expert and user feedback/input
- Serve as the NASA entry/exit point for space environment products
  - Test facilities, capabilities and expertise
  - Space weather products and data
  - Transition of research to applications

Established Contacts

Institution	NASA Working POC	Contacts
HQ		Dick Fisher, Vicki Elsbernd, John Lyver, Dana Brewer
MSFC	Dave Edwards, DeWitt Burns, Jim Spann	Todd May, Andrew Keys, Bonnie James (HQ/OCT), Dan Dumbacher
GSFC	Mike Xapsos, Sharon Straka	Michael Hesse, Jim Slavin, Janet Barth, Mike Xapsos, Ken Label, Sharon Straka
GRC	Kim DeGroh, Don Jaworske	Viet Nguyen, Mike Piszczor, Kim De Groh
JPL	Hank Garrett	Hank Garrett, Paul Willis, Insoo Jun
JSC	Ed Strong	Ed Strong, Brandon Riddel, Neal Zapp
LRC		Judith Watson, Deborah Tomek
NESC		Steve Gentz
NOAA		Tom Bogdan, Terry Onsager, Bill Lapenta, Doug Biesecker
US Army SMDC		Larry Burger, Steve Pierce
ONR		Robert McCoy

Initial Steps

- Establish ASE office
- Establish working Groups
- Identify Subject Matter Experts
- Hold Kick-Off ASE workshop
- Identify ASE technical area needs
- Establish Business Processes (to fund the work)

Follow On Approach/Plan

- Maintain small Program Office staff (light touch)
- Fund product development and transition activities
- Disseminate Products to the public/users
- Maintain ASE coordination thru:
  - Working group participation
  - Subject Matter Experts (SME's)
  - Knowledge of specialized test facilities
- Work with SMD/ESMD/SOMD/OCT to establish space weather instrument package – Geospace and Deep Space

Summary

- Problem
  - A gap exists between spaceflight environments knowledge and the application of this knowledge for multi-program ,cross cutting use.
  - No funding for transition from research to applications
  - Lack of NASA coordination at the agency level
  - No one owns the problem
- To resolve this problem, establish a NASA organization that will provide coordination and funding for sustained multi-program support in three technical areas that have a demonstrated need through customer pull.